TRANSCRIPTION OF THE MEMORANDUM FROM P. EUGENIO BARSANTI AND FELICE MATTEUCCI TO THE ACCADEMIA DEI GEORGOFILI ON 5 JUNE 1853

"A report concerning certain new experiments carried out by Eugenio Barsanti and Felice Matteucci who left a sealed copy of the same with the Accademia dei Georgofili during the meeting of 5 June 1853, as shown in the Minutes of the meeting:
"Some time ago the undersigned developed the concept of using an electric spark to ignite a combination of oxygen and hydrogen that would create a driving force. Since early January of this year, they have continued to experiment having learned that others who had decided to use the same driving force – albeit in a considerably different way - did not wish to delay submitting a Report with the Accademia dei Georgofili in which statements were certified by the declarations of trusted and distinguished persons who learned about and, in part, witnessed the said experiments.
The Report describes concept procedure, method and the results of the experiments, the purpose of which is to avoid being accused of profiting from other people's ideas when they are in a position to make their findings public.

From the moment that the undersigned decided to apply this new force, they realised that two fundamental studies had to be carried out.

I. Find a way of obtaining the detonating mixture at the best possible price.
II. Transform the instantaneous movement generated by detonation in to regular, sequential and smooth movement.

From the first study it was immediately obvious that the cost of obtaining oxygen from the decomposition of water by acids or voltaic pile would not be competitive with machines driven by steam or the heated air of the Ericsson system.
Until a method is found for obtaining oxygen at the best market price – and the undersigned have formulated certain notions which they will experiment – it would be better to relinquish the advantages of pure oxygen and be satisfied with combining hydrogen and air.

There were considerable problems with the application of this concept with regard to the correct proportions of air and hydrogen and the addition to the composition of 80 parts nitrogen to 100 parts air meant that 5 parts nitrogen and 7 parts of the mixture would have remained in the container in which ignition was to take place, in addition to the fact that a small amount of water resulted from combining the other two gases: but this problem was resolved, as we shall see in a moment.
First of all, it must be explained that the equipment used for these experiments is basically an iron cylinder with strong walls containing a piston with a rod that passes through the centre of a lid held in place by screws at the top; the length and shape of the rod prevents the piston from travelling to the bottom of the cylinder; the piston divides the cylinder into two spaces – the one above is 60 cm long and 9 cm in diameter and the much shorter and wider one below is 12 cm long and 10 cm in diameter and closes hermetically at the bottom. It is in this smaller space - which we will call the chamber - that the gaseous mixture must ignite and its explosive force drives the piston upwards.

Fitted with a valve a disc rubs against the side of this space to extract the products of combustion through a hole in the bottom of the chamber, allowing the gaseous mixture to enter at the top. At the end of its travel it produces exhaust.
As mentioned, it was not possible to apply this new system of a rod and a piston that travels rapidly as if it were struck hard by a hammer and a way had to be found for transforming this instantaneous movement into sequential and regular motion.

Four systems were envisaged for achieving this purpose:

1° Fit a sealed box to the cover or the bottom of the upper chamber through which the piston rod passes such that air between the bottom of the piston and the bottom of the chamber will not escape; when the air is compressed by the blow and tension is reduced by several atmospheres, the piston is forced to travel upwards. The useful desired effect on upward and not downward travel is achieved by especially constructed gears and mechanisms.

2° Achieve air compression in the same way but with the purpose of thrusting it into a so-called airbox by means of an additional tube fitted with a valve that opens inside and outside the airbox through which one or two dual-effect cylinders could pass in the same way as with steam and would not be unlike those in the machines currently in use: it goes without saying that the cover containing the sealed box must be fitted with a valve that opens outside and inside to allow new air to enter; after forcing the piston to the end of its travel, the air must be compressed again and thrust into the aforementioned box by the returning piston.

3° The piston would no longer operate in a hermetically-sealed cylinder but would be open at the top, where it would be sufficient for the rod to encounter a guide; lengthen the upward stroke of the piston system by springs or other elastic elements by which it would produce the useful effect on its return by reacting to the force received from the piston once thrust has stopped.

4° Make the piston operate inside a cylinder that is open at the top, as in the previous case; the length and width of the cylinder should be such that the piston cannot be expelled by the expansion force. In this case, a void would be formed below the piston during its downward stroke; the useful force obtained would be atmospheric pressure at its base.
The experiments undertaken to date involved the first system which gave satisfactory results as to the strength of the force produced having condensed the air to four atmospheres, but it left much to be desired with regard to the hoped-for return of the piston by the downward effect of compressed air.

This result can be attributed to the fairly imprecise construction of the device and to the loss of air heat – to the detriment of elasticity - against the walls of the cylinder in its development during violent compression. The former cause could be removed by more perfect construction; if nothing else, the latter could be considerably diminished when – in the case of a machine constructed in accordance with the already formulated principles in such a way that it operates totally independently - the required rapidity of motion would be achieved and would be capable of heating the walls of the container. In addition to this, it is thought that if this container receives heat from the air at every stroke, after some time it will become saturated, especially if it is made of material that is fairly nonconductive or, at least, surrounded by insulating material.
No experiments were carried out on the second system due to a lack of the necessary means for obtaining a machine that must be perfect and not unlike ordinary steam engines, with the exception

of replacing the boiler with an airbox and the substitution of all the accessories required for making and regulating steam.

But here we take the liberty of observing that once the first experiments convinced us of the possibility of condensing air to a considerable number of atmospheres equal to that of steam in boilers, and that the relationship between the condensing cylinders, the airbox and the engine cylinders had been well-defined, there can be no doubt about the effect of this force of expansion. If this system has an advantage it would be its application to machines that are already built to operate by steam.
The third system requires instruments that are less perfect and very simple mechanisms and will be experimented just as soon as we have obtained the elastic elements that have been ordered.
The fourth system will not be experimented unless unexpected problems arise with the third.
As these are simple effect systems, it goes without saying that dual cylinders with alternate motion must be used in practice.
It is not sufficient to demonstrate the effect of this new force by experience alone and we want to re-evaluate it in theory and with calculations; but without expounding further on the subject suffice it to say that the results we obtained are sufficiently in agreement with those construed from experience."

Florence, 1 June 1853

Eugenio Barsanti of S.P. (Piarists Schools)
Felice Matteucci

We, the undersigned, take note of the above indicated experiences:
Giovanni Antonelli S.P.
Tito Gonnella
Pasquale Poccianti
Emilio Bechi
Filippo Cecchi S.P.